CHAPTER 1

Child Philosophers: Are Smart Machines Alive?

It is summer. Robert, seven, is part of a play group at the beach. I have been visiting the group every day. I bring a carton filled with small computer toys and games and a tape recorder to capture the children’s reactions as they meet these toys. Robert is playing with Merlin, a computer toy that plays tic-tac-toe. Robert’s friend Craig has shown him how to “beat” Merlin. There is a trick: Merlin follows an optimal strategy most of the time, and if neither player makes a bad move every game will end in a draw. But Merlin is programmed to make a slip every once in a while. Children discover a strategy that will sometimes allow them to win, but then when they try it a second time it usually doesn’t work. The machine gives the impression of not being “dumb enough” to let down its defenses twice. Robert has watched Craig perform the “winning trick” and now he wants to try it himself. He plays his part perfectly, but on this round Merlin too plays a perfect game, which leads to a draw. Robert accuses it of being a “cheating machine.” “And if you cheat you’re alive.” Children are used to machines being predictable. The surprising is associated with the world of the living. But this is a machine that surprises.

Robert throws Merlin into the sand in anger and frustration. “Cheater. I hope your brains break.” He is overheard by Craig and Greg, aged six and eight, who sense that this may be a good moment to reclaim Merlin for themselves. They salvage the by now very sandy toy and take it upon themselves to set Robert straight.
Craig: “Merlin doesn't know if it cheats. It won't know if it breaks. It doesn't know if you break it, Robert. It's not alive.”

Greg: “Someone taught Merlin to play. But he doesn't know if he wins or loses.”

Robert: “Yes, he does know if he loses. He makes different noises.”

Greg: “No, stupid. It's smart. It's smart enough to make the right kinds of noises. But it doesn't really know if it loses. That's how you can cheat it. It doesn't know you are cheating. And when it cheats it doesn't even know it's cheating.”

Jenny, six, interrupts with disdain. “Greg, to cheat you have to know you are cheating. Knowing is part of cheating.”

The conversation is over. I found it a striking scene. Four young children stand in the surf amid their shoreline sand castles and argue the moral and metaphysical status of a machine on the basis of its psychology: does the machine know what it is doing? does it have intentions, consciousness, feelings?

What is important here is not the yes or no of whether children think computers cheat or even whether computers are alive. What is important is the quality of the conversation, both psychological and philosophical, that the objects evoke.

Millions of parents have bought computer toys hoping they will encourage their children to practice spelling, arithmetic, and hand-eye coordination. But in the hands of the child they do something else as well: they become the occasion for theorizing, for fantasizing, for thinking through metaphysically charged questions to which childhood searches for a response.

It was Jean Piaget who discovered the child as metaphysician. Beginning in the 1920s, Piaget studied children's emerging way of understanding such aspects of the world as causality, life, and consciousness. Children begin by understanding the world in terms of what they know best: themselves. Why does the stone roll down the slope? “To get to the bottom,” says the young child, as though the ball had its own desires. Childhood animism, this attribution of the properties of life to inanimate objects, is only gradually displaced by new ways of understanding the physical world in terms of physical processes. In time the child learns that the stone falls because of gravity; intentions have nothing to do with it. And so a dichotomy is constructed: physical and psychological properties stand opposed to one another in two great systems. The physical is used to understand things, the psychological to understand people and animals. But the computer is a new kind of object—psychological, yet a thing.

Marginal objects, objects with no clear place, play important roles. On the lines between categories, they draw attention to how we have drawn the lines. Sometimes in doing so they incite us to reaffirm the lines, sometimes to call them into question, stimulating different distinctions. They are the growing point for new learning, new theory building. Computers, as marginal objects on the boundary between the physical and the psychological, force thinking about matter, life, and mind. Children use them to build theories about the animate and the inanimate and to develop their ideas about thought itself.

Marginal objects are not neutral presences. They upset us because they have no home and because they often touch on highly charged issues of transition. Sit silently and watch children pulling the wings off butterflies, staring at the creatures with awesome concentration. When they do this, children are not simply being thoughtless or cruel. They are not playing with butterflies as much as with their own evolving ideas, fears, and fantasies about life and death, about what is allowed and what is not allowed, about what can be controlled and what is beyond control.

Piaget discovered the child as metaphysician and set a style for investigating children's thinking. He tried to understand children's theories in intellectual terms. Piaget interviewed children, asking them, for example, whether clouds, dogs, rocks, and many other familiar objects were alive. Or he gave them problems and examined their solutions. His style of inquiry tries to probe what children think. I follow his example, but I also have another concern. Beyond what children think, I am interested in what they feel, and how what they feel enters into the development of their thought. The development of logic is pushed forward by children's emotional as well as intellectual needs. There is passion behind theory construction.

In my research on how computers enter children's thinking, my method is like Piaget's in that I asked children direct questions, but I did something else as well. I observed what children did with computers and computer toys in natural settings where computers provoked excitement, conversation, and disagreement. Sometimes children who would say computers were "not alive" betrayed more complex feelings by treating them as though they were.

The butterfly can play its role as an evocative object because it is
on a threshold, alive enough to fly, yet seemingly far enough from being alive in the way that a person is alive to make its mutilation and killing almost acceptable. And when the butterfly’s wings have been torn from it, it is placed in another situation betwixt and between. When does it stop being a butterfly? At what point is it dead? The computer too evokes feelings and thoughts related to life, death, and the limits of permissibility and control. It too is seen as marginal, in some ways alive and in many not. Thus it is like bugs and butterflies. But it introduces something new.

The world of bugs and butterflies is like the world of Humpty-Dumpty: “All the King’s horses and all the King’s men couldn’t put Humpty together again.” Computers belong to a different world. They offer an experience of restoring “life” as well as ending it. The computer’s interactivity and complexity—the fact that it is “smart” and “talks back”—make some children see it as one of those things on the margin of being alive. It is also possible to play with the idea of “killing” the computer. Certain inputs will “crash” it: the program, unable to cope, is thrown into a nonfunctioning state. The crash, an event often accompanied by a violent burst of gibberish on the screen, can carry a high emotional charge. Watching children go through cycles of crashing and reviving, of “killing” and “resuscitating” their machines, suggests that they are using them to work through feelings about endings and beginnings, about life and death.

In this chapter I first look at a number of such situations where the computer, marginal and evocative, provokes strong emotions, even fear. Later I shall talk about how children develop theories that among other purposes may serve to banish their fears. Through the construction of concepts the child tries to put order where there was disorder. The computer, standing between the physical and the psychological, between the animate and the inanimate, creates a new disorder and provokes the child to new conceptualizations.

Why the Computer Disturbs

Matthew, a good-natured and precocious child of five, was eagerly learning to write computer programs to make graphic designs on the screen. His mood changed abruptly and he left the computer in tears when he understood how to make a recursive program: a program whose action includes setting in motion an exactly similar program whose action includes setting in motion an exactly similar program, and so on. Once started, the program will (if it has no “stop rule”) go on “forever,” limited only by the hardware, the amount of “memory” of the machine.

It is not enough to say that Matthew was afraid. His experience was complex and confusing, one that many people have shared. When I was a little girl I had a book on the cover of which was a picture of a little girl looking at the cover of the same book, on which, ever so small, one could still discern a picture of a girl looking at the cover, and so on. I found the cover compelling, yet somehow it frightened me. Where did the little girls end? How small could they get? When my mother took me to a photographer for a portrait, I made him take a picture of me reading the book. That made matters even worse. Whenever I looked at the photograph or the book I couldn’t stop thinking about them, yet could find no way to capture for myself or for anyone else exactly what it was that was so upsetting and so gripping for me.

Other children meet this experience in the form of questions about where the stars end or whether there is ever a final image when mirrors reflect mirrors. In all of these cases, what disturbs is closely tied to what fascinates and what fascinates is deeply rooted in what disturbs.

When I was in trouble with self-referential pictures I could get no help. The adults around me were no better able to handle the infinite series of ever smaller little girls than I was, except to assert their authority by telling me not to think about such things. Children’s encounters with ideas like self-reference, infinity, and paradox are disturbing and exciting and are made all the more mysterious by the fact that appeals to parents about them are likely to provoke frustrating admonitions not to think about such slippery questions. Yet such questions become storm centers in the mind.

The computer touches on several of these slippery questions. The idea of infinity is one of them. What constitutes being alive is another.

Young children see almost everything in the world as alive in one way or another. This “animism” pervades the child’s thinking until the development of concepts that help draw the line between the alive and the not-alive. Childhood animism has two faces: it
makes the world friendly and understandable, but it can make it frightening as well. Emerging from animism is more than a chapter in the intellectual development of the child—it is a struggle against the insecurities that come from not knowing what objects can act independently and potentially antagonistically. Children spend a great deal of energy trying to get such matters under control, and thus it is not surprising that they are disturbed when a computer behaves halfway between a person and a thing.

For the child for whom little seems under total control, toys and simple machines are reassuring exceptions. Dolls, soldiers, wind-up toys—all of these “come alive,” but only at the child’s command. Computer toys that talk, cheat, and win are not so compliant. Yet they have a “holding power.” In part it is the holding power of the feared. Children love roller coasters and horror movies, but much of the time on the ride and in the theater may be spent with closed eyes. We are drawn to what frightens us, we play with what disturbs us, in part to try to reassure our control over it.

Laura is six years old, a beautiful child from suburban Boston. Her family calls her “Princess.” I have interviewed several other six-year-olds from her neighborhood. Most of them seem street-wise. Laura is an innocent. She watches very little television, some Sesame Street, and her favorite, Mister Rogers’ Neighborhood, which she likes because “there is magic and Mr. Rogers is very kind.” She has no mechanical toys, “nothing that winds up or has batteries,” she tells me, “just dolls and storybooks.” As we chat, sprawled on the floor of my office, she remarks that she has never played with a tape recorder or a typewriter, and she gingerly tries mine off. And yet, when she is presented with the computer toys—Simon, Merlin, and Speak and Spell—she has no reticence. “My mother has a microwave like this,” is her first comment about the touch-sensitive controls on Merlin, the toy that plays tic-tac-toe.

Laura begins her play session calmly. She quickly checks out the toys and has definite opinions. The toys have “minds,” says Laura, but they are not alive, because “they don’t have a brain—they know how to do things with minds.” Laura says this in a tone that suggests disbelief that anyone could think otherwise. Of all the things she has ever met before, she thinks that Merlin is most like “a machine, a clock.” And the thing that Laura says is most special about clocks is that “they don’t do anything by themselves.” When I ask Laura if her alarm clock “remembers” when to wake her up, she is firm about the answer. “No, you set it. And then it does it. But not by itself.”

As Laura plays she becomes less composed. Merlin’s “tic-tac-toe mind” turns out to be a formidable opponent. “How does he win so much? It tries to make me lose.” Laura is completely engrossed. She doesn’t look up. My presence is forgotten. I ask her if she thinks Merlin could lose if it made a mistake. Her “Yes” is almost inaudible. She is not sure at all. Laura begins to turn Merlin off between games, a ritual whose intent seems to be to weaken the toy. Her efforts are in vain: Merlin continues to win. After five minutes of this frustration, she puts Merlin aside and picks up Speak and Spell, a toy that can talk. Laura spells out her name on its keyboard. The toy obediently calls out the letters and displays them on a small screen: “L-A-U-R-A.” She seems satisfied and relaxes. This is going to be more reassuring than Merlin. Then Laura puts Speak and Spell into “Say it” mode.

Speak and Spell has a button that turns it on and another that turns it off. It also has buttons for choosing among different possible play modes. In “Spell” mode, the toy calls out a word and waits for the child to spell it by pressing out letters on its keyboard. After the child has made a guess, the game offers congratulations or a second chance before it provides the correct spelling. In the “Hangman” game mode, the toy offers blank spaces and clue letters on the screen and invites the child to complete the secret word. And then there is “Say it” mode, designed for younger children who, like Laura, may not be able to spell much more than their names. In “Say it” mode the machine calls out the phrase “say it” followed by one of the words in its several-hundred-word vocabulary: “say it . . . happy,” “say it . . . lose,” “say it . . . house.” And the child is given a few seconds to repeat the word before being offered another one.

Not surprisingly, since this is the way of electrical objects, Speak and Spell is designed so that you can turn it off at will. You can turn it off without finishing the “Hangman” guessing game or without completing the spelling of a word in progress. But the first version of Speak and Spell that came on the American market had

* It has become almost a convention to capitalize the names of computer programs and of all “output” from computer programs. When I depart from convention it is because the program’s authors have done so.
a "bug," a programming mistake: you can't turn it off while it is in its “Say it” mode. This mode offers ten words, ten “Say it” commands, and it brooks no interruption until the presentation of the ten words is finished. You cannot change modes, and you cannot turn the toy off.

When Speak and Spell is in “Say it” mode its program doesn’t check to see whether the user has pressed “Off” before completing its ten-word cycle. Although the programming error is trivial, it was discovered only after it had been “burned into” the computer chip manufactured for the toy. Correcting the mistake was deemed too costly. And, besides, the problem didn’t seem very serious.

The uninterruptible “Say it” cycle takes long enough so that within their first few sessions with Speak and Spell most children try to turn it off while it is in “Say it” mode and discover they cannot. In a small way, they are meeting a situation that is at the heart of almost every science fiction movie ever made about a computer. It is the story of the machine out of control. As far as the child can tell, this machine has developed a mind of its own.

Halfway through the cycle, Laura wants to turn “Say it” off and get back to spelling her name. She presses the “Off” button. She persists, pressing it again and again, then trying several other buttons. "Why isn’t this thing coming off?" She tries four or five buttons in a row, then all of them at once. Now Laura is panicked. She puts one of her hands on as many buttons as it will cover. She tries both of her hands. The machine goes on until it is done. Laura is quite upset.

The "Say it" bug contradicts our most basic expectation of a machine. When you turn the switch to “Off,” machines stop. The cliché response to people’s fears about computers “taking over” is that you can always "pull the plug." Laura’s agitation is not unlike that of an adult who suddenly has reason to doubt the cliché.

Children can be frightened by the "Say it" bug, but at the same time they find it compelling. Once they discover the bug, they make it happen again and again. It gives them a chance to play with the machine as alive, out of control.

When Paul, seven, discovers the "Say it" bug, he is startled, but he doesn’t say anything. His first reaction is to put Speak and Spell down on the ground. Then, kneeling above the toy but keeping some distance, he presses “Say it” again. This time, Paul presses all of its buttons in turn and then uses the palms of his hands, trying to press all of its buttons at the same time, trying to make it stop. The toy remains unobedient, but when its ten words have come to an end it stops unexpectedly. Paul puts the Speak and Spell in “Say it” mode again, but this time, just as it is demanding its fourth word, Paul turns it over, opens its back cover, and removes its batteries. Paul has found the way to “pull the plug.” A group of children gather round. Most have run into the “Say it” bug, but no one had thought of batteries. There is much excitement. The children take turns doing Paul’s trick. They put the toy in “Say it” mode and then take out the batteries, all the while shrieking their delight about “killing the Speak and Spell.” The children allow the toy its most autonomous behavior, and then, when it is most like a living thing, they kill it.

The children are not only killing the Speak and Spell, they are also bringing it back to life. Somewhat older children play with more sophisticated computers in similar ways. As I have said, they delight in "crashing" the system, in overloading it or getting it into a state where it will not be able to function, and then they "bring it up" again.

In the first computer-rich elementary-school classroom I studied, there quickly grew up a community of experts at crashing and reviving the computer, skills that demanded considerable sophistication. This group of ten-and eleven-year-old experts didn’t crash the system to inconvenience the teachers or the other students. They crashed the system in order to watch it go down and have an occasion to bring it up. After a few weeks of incessant crashes and virtuoso resuscitations, Peter and John, the two most skilled experts, developed a new variant on the crash/revive routine. They wrote a computer program that simulated a crash. This program made the computer appear ready for the "log in" command needed to "wake up" its operating system. But when someone went through the procedure of logging in, the screen would go blank, the system apparently dead. This would give the authors of the "pseudocrash" program an opportunity to do their "magic"—to type in a few characters and revive the machine.

At the time I was struck by the dramatic and witty flair of these fifth-grade "pseudocrashers." They seemed quite extraordinary. But in the years that followed, I saw that this episode was typical. Sooner or later, wherever there is a computer complex enough to make mastering its operating system a challenge, there develops
the culture of the crash and the appearance of some variant of a pseudocrash program.

I ask a four-year-old named Ralph to draw a picture of something “not alive.” He takes a large piece of paper and concentrates on weaving a small, dense mesh of lines in the middle of the sheet with a black crayon. And then he asks me to write out the name of the picture for him: Spider. Ralph looks up and announces, “Spiders are not alive.” “Why?” I ask. He replies, “Because you can kill them.”

Ralph has observed that spiders and ants can be stepped on, killed without hesitation, and to Ralph this makes them less alive to the point where he is willing to say they are not alive. But, of course, he contradicts himself, because you can’t kill something that doesn’t live. The tension in his answer shows him aware of the insect’s marginal status as a living thing, a marginality that gives “permission” to experiment with the taboo on killing.

Speak and Spell in its “Say it” mode is also on the border. It is not alive, but seems to act willfully, of its own accord. Like the “marginal” insects, it can be an occasion for what seems an almost ritual exploration of life and death: pulling out the batteries and putting them back again. Appreciating the emotional charge of this ritual brings a more complicated and paradoxical picture of what is at stake when a child thinks about whether or not a computer is alive. Seeing the computer as alive adds to the emotion of killing it. But the relationship goes both ways: the excitement of killing the toy, of crashing the program, is itself an inducement to seeing the computational object as alive. It is exciting to play with the idea of life and death, and it is exciting to feel responded to by a “living” machine. Adults are not exempt from this excitement. Some would who instantly reject the suggestion that computers are alive are drawn into behaving toward a computer as though it were alive. Some philosophical stances are taken in action.

In the early 1970s, computer scientist Joseph Weizenbaum wrote what by now must be the most widely quoted computer program in history. This was the ELIZA program, which was “taught” to speak English and “make conversation” by playing the role of a psychotherapist, an extremely clever twist. The project of making a computer program that can enter into dialogue on all possible subjects is far beyond anything that is technically possible at present. Some experts doubt that it can ever be done. But setting the context for a conversation with ELIZA in the consulting room solved a lot of problems. Certain psychotherapists use a technique of “mirroring” what their clients say to them. Thus, if the patient says, “I am having problems with my girlfriend,” the therapist might say, “I understand that you are having problems with your girlfriend,” or “Why do you tell me that you are having problems with your girlfriend?” This technique is convenient for ELIZA. It allows the program to make an acceptable response without knowing the meaning of what has been said.

The program is able to give its response by making a few grammatical substitutions: “you” for “I,” “are” for “am,” and then adding as a prefix a random selection from a list of stock phrases used in the technique of mirroring, such as “I understand that...” or “Why do you tell me that...?” or “Are you telling me that...” So, for example, if you say to ELIZA, “I am happy,” it will analyze the sentence as “I am” plus “X,” transform “I am” into “YOU ARE,” and add a prefix such as “Why do you tell me that?” and say, “Why do you tell me that you are happy?” Some versions of ELIZA were made a little more varied and interesting by providing the program with lists of words that would trigger certain responses. The words “miserable,” “unhappy,” “sad,” and “depressed” might trigger the program to use the stock phrase “I am sorry to hear that” in the sentence that followed.

ELIZA was a “dumb” program. It could recognize the character strings that make up words, but it did not know the meaning of its communications or of those it received. To ELIZA, the string D-E-P-R-E-S-S-E-D called up one of a set of possible “boilerplate” prefixes, but the program did not have any further knowledge about what it means to be depressed.

Weizenbaum’s students and colleagues who had access to ELIZA knew and understood the limitations on the program’s abilities to know and understand. And yet, many of these very sophisticated users related to ELIZA as though it did understand, as though it were a person. With full knowledge that the program could not empathize with them, they confided in it, wanted to be alone with it.

As one becomes experienced with the ways of ELIZA, one can direct one’s remarks either to “help” the program make seemingly pertinent responses or to provoke nonsense. Some people embark on an all-out effort to “psych out” the program, to understand its
structure in order to trick it and expose it as “mere machine.” Many more do the opposite. I spoke with people who told me of feeling “let down” when they had cracked the code and lost the illusion of mystery. I often saw people trying to protect their relationships with ELIZA by avoiding situations that would provoke the program into making a predictable response. They didn’t ask questions that they knew would “confuse” the program, that would make it “talk nonsense.” And they went out of their way to ask questions in a form that they believed would provoke a lifelike response. People wanted to maintain the illusion that ELIZA was able to respond to them.* Children are often more direct in expressing their desire to breathe life into their machines. Lucy, five, is the youngest child in her day-care group. She is plump, small for her age, teased by the other children. She badly needs a friend. On the first day I come to work with the children in her group, Lucy discovers my Speak and Spell. They become inseparable. That evening she convinces her mother to buy her one of her own. It becomes her constant companion. Soon she has worked out a special way of keeping it “alive.”

Speak and Spell has a speaker but no microphone. The only input it can receive is letters typed into its keyboard. But in fantasy Lucy modifies her toy. She uses its speaker as her microphone. She calls it Speak and Spell’s “ear,” and talks to it. First she speaks softly, “What do I have to spell to you?” And then, more insistently, “What should I spell?” Now screaming, “Tell me!” At this point and always at this point (for this is a sequence I watched many times) Lucy presses the “Spell” button and the toy speaks. This time it says, “SPELL...GIVE.” Lucy settles back, obviously content: she has gotten the toy to address her. Her favorite way of interacting with the toy is to put it in “Say it” mode and to go into “Say it” mode herself, injecting her own “Say it” in the few seconds between the machine’s “SAY IT” and its pronouncing the word it “wishes” to have said. So the dialogue between Lucy and Speak and Spell goes like this: Speak and Spell: “SAY IT...” Lucy: “Say it...” Speak and Spell: “...LOSE...” Lucy: “That’s right, you’re very good.”

The other children boss Lucy around, and now she too has someone to bully. Lucy wants to give the toy an awareness of her. She wants to give it consciousness and a psychology. She describes Speak and Spell as “a little alive.” She wants it to be.

In the child’s animistic world, objects can have the power of active agents, with unknown, perhaps sinister intentions. Laura was simply afraid, but with Lucy we see a first strategy for how children deal with the situation. They play with and manipulate objects to get a sense of control over their powers. Lucy wants Speak and Spell to be alive, and an important part of wanting it to be alive is then to be in a position to bring it under control.

Paul used this strategy when he entered into cycles of putting Speak and Spell in “Say it” mode and pulling out its batteries. But this strategy can bring you only so far. Children often seem to have infinite patience for taking apart and putting back together, for doing and undoing. But there is a limit. Eventually something has to change within them to bring fears under control. One possibility: repress what threatens. For example, the child “forgets” the terrors of infinity. Another: weave intricate associative threads that join what is frightening with what is not.

When the young child sees clouds moving across the sky, the clouds may seem alive and independent, perhaps dangerous. But if one sees clouds as fleecy lambs, a metaphorical chain begins to neutralize the fear. The cloud may still be thought of as alive, but it is no longer terrifying. Repression and neutralization through metaphor are possible strategies, but there is another. Faced with the moving clouds, the child can theorize about their movement in such a way that the clouds cease to be alive. “Cloud movement” becomes differentiated from the kind of movement that makes things alive, because the clouds move only if they are “pushed” by the wind, and what can’t move without a push from the outside is
not alive. Children develop theoretical constructs that separate the motion of clouds from the motion of people and animals so that eventually the fear of living clouds disappears. If things seem uncomfortably on the border between the alive and the not-alive, use logic to redefine the boundaries so that things fall more comfortably into place. If it scares you, make a theory.

Children construct theories that will help them situate the computer in the world of living and not-living things and neutralize what seems threatening about it. How do children come to define the ideas of life, thinking, and feeling in a way that takes account of what computers can do?

A New Disorder: “Are Smart Machines Alive?”

In the discussion of the children on the beach, Robert said that he thought Merlin was alive. Long before computers appeared, children held unorthodox views about what things were alive just as they held unorthodox views about why rocks rolled down slopes. When, in the 1920s, Piaget explored what children think is alive, he noted that children at the age of those on the beach frequently thought objects such as clouds or rivers to be alive. So it is surely to be expected that some children should think of computer objects, which are in many ways more lifelike than clouds or rivers, as alive. But when we compare children’s ideas about the “aliveness” of computer objects to their ideas about the objects that surrounded the children Piaget studied, we see important differences, differences that again reflect the computer’s status as an object somewhere between the worlds of psychology and physics.*

Piaget argues that children develop the concept of life by making finer and finer distinctions about the kind of activity that is evidence of life. In particular, the notion of life is built on progressive refinement of their concept of motion. At age six, a child might see a rolling stone, a river, and a bicycle as alive for the same reason: “they go.” By age eight, the same child might have learned to make a distinction between spontaneous movement (movement that the object can generate by itself) and movement imposed by an outside agent. This allows “the alive” to be restricted to things that seem to move of their own accord: a dog, of course, but also the sun, the rain, a cloud. An object drops out of the category of alive when the child discovers an outside force that accounts for its motion. So, at eight, the river may still be alive, because the child cannot yet account for its motion as coming from “outside of itself,” but the stone and the bicycle are not alive, because the child can.

Cars and other motorized vehicles challenge this classification scheme, but children can adapt “pushing from without” to include the “push” that comes from starting a motor. Children distinguish those mobile things that move by themselves from those that move at the command of a living entity. It is not until eleven or twelve that they confine the concept of life to plants and animals, when the idea that internally generated motion confers life is refined by ideas about growth (things are alive if they grow) and other life activities such as breathing or metabolism.*

At different stages in a child’s development, trees could be alive because their branches wave, then not alive because they stay in the same place, and, finally, alive again because they grow or because sap flows in them—a form of internally generated motion. The motion theory leads to misclassifications: the stationary trees that are not alive, the moving clouds that are. But these misclassifications are not consequential for children. Children can climb a tree and swing from its branches whether or not they think the tree is alive. And concepts such as metabolism that would make trees alive are far from children’s everyday concerns. The motion theory is satisfying even though it does not always lead to the correct conclu-

* This is the story as Piaget told it. When one looks at the details of his data, and at subsequent research, including my own, one sees that some qualification is needed: the majority of responses of children do refer to motion in the strict sense of moving from A to B, but at all stages there are some responses that refer to motion in an extended sense, as physical activity: the “kettle boils,” the “top spins.” My purpose here is to contrast all such physical criteria, including the occasional reference to biology—“coming out of eggs,” “being born”—with a very different kind evoked by computational objects. From this perspective, the difference between strict motion and physical activity is not relevant, and so I use the phrase “motion theory” in a generalized sense, to cover all references to physical as opposed to psychological criteria in talking about what is alive.
sions. And it is a good theory to grow with—it grows in complexity and differentiation with the child's development of increasingly complex and differentiated ideas about the physical world.

Children build their theories of what is alive and what is not alive as they build all other theories. They use the things around them: toys, people, technology, the natural environment; a rapidly running stream, the wind that dies down and starts up again, the jerky movements of a wind-up toy—these are objects to think with, to build with. The motion theory for distinguishing the living from the not-living corresponds to the world of objects that surrounds children: animate objects—people and animals who act and interact on their own—and all the other objects, pretty well inert.

But this orderly situation has changed with the coming of the computer. Children are now confronted with highly interactive objects that talk, teach, play, and win. Children are not always sure whether these are alive or not alive, but it is clear, even to the youngest child, that movement is not the key to the puzzle. Children perceive the relevant criteria not as physical or mechanical, but as psychological: Are their electronic games aware, are they conscious, do they have feelings, do they play fair, or do they cheat?

Children use a psychological discourse to talk about other things than computers. One five-year-old told me that a cloud is alive "because it gets sad. It cries when it rains." Another five-year-old said, "The sun is alive because it has smiles. People paint smiles on the sun." But if an eight-year-old argues that clouds or the sun are alive, the reasons given are almost always related to their motion—their way of moving across the sky and the fact that they seem to do so of their own accord. By contrast, as children become older and more sophisticated their arguments about the computer's aliveness become focused on increasingly refined psychological distinctions. The motion theory of life can be adapted to take account of the automobile, but it is much harder for it to adapt to computer toys that do not move but are unrelentingly active. The child faces the computer with its lifelike properties: it talks, it wins at games, it knows facts. At the same time, the machine has properties that make it seem not alive. This creates a predicament. The computer provokes children to find ways either to deny it the status of a living being or to grant it a special kind of life. In the process it forces them to think about how machine minds and human minds are different and so enters into the development of psychological reasoning. It enters into thinking about mind: about computers' minds, other people's minds, and one's own mind.

The Construction of the Psychological

I studied over two hundred children from age four to fourteen, exploring how they interacted with and spoke about computer objects, from hand-held electronic toys and games to video games and personal computers. Some care is needed to pin down exactly what is new. It is not a simple matter of children thinking that computers are alive. Children disagree and discuss the question with interest.

Elvira, four, says that Speak and Spell is alive "because it has a talking voice in it." Ingrid at five: "It's alive—it talks." Randall, an eight-year-old, says with an air of confidence and authority, "Things that talk are alive." Kelley, six, gives an answer with a different twist. She looks closely at the seven-by-ten-inch Speak and Spell and pronounces, "It's alive—there's a man inside who can talk." But eight-year-old Adam disagrees with five-year-old Lucy, who is sure that Speak and Spell is alive "because it talks. "OK, so it talks, but it's not really thinking of what it's saying. It's not alive." Adam's reply would have been a conversation stopper for most adults, but Lucy is not intimidated: "You can't talk if you don't think, Adam. That's why babies can't talk. They don't know how to think good enough yet." What is new is that psychological principles are used to argue both sides of the question.

Piaget too reported that children occasionally used "talking" as a reason for believing something to be alive, but reference to talking in his protocols was so isolated, so occasional, and so undeveloped that he dismissed it as not an essential part of children's construction of a theory of aliveness.* For the children I studied, "talking"

* "The child will add to its spontaneous ideas various adventurous definitions: to live is to speak, or to be warm, or to have blood, etc. But all the children who gave these secondary definitions were also able to give the usual answers, all being simply juxtaposed together, so that it was possible to neglect these various secondary notions whose completely individual character clearly showed them to be the result of chance conversations overheard, etc." Jean Piaget, The Child's Conception of the World (Totowa, N.J.: Littlefield, Adams, 1975), pp. 195-96.
was not isolated at all. When today's child confronts a computer toy, talking is part of a larger set of attributes used to construct the notion of alive/not alive. These attributes are psychological, and as the child grows in sophistication they are used in increasingly sophisticated ways.

There is room for debate about whether what children say when you question them about if and why something is alive accurately reflects what features they are really using to decide the answer. A child's verbal answer may be determined by what is easiest to say or by an attempt to guess what kind of answer the questioner expects. One does not have to resolve this debate about the Piagetian method in order to see that something changes when we go from traditional objects to computational ones. The most frequent pattern I found was that children who had consistently placed traditional objects into the categories of alive and not alive on the basis of physical activity, usually by delegating the stationary to the status of the nonliving, used psychological reasoning when they came to a computer toy. The arguments children use most frequently to discuss whether a computer is alive do not refer to the computer as a physical entity but to the computer as a psychological entity, to ways in which it seems or does not seem to be like a human being in the qualities of its "mind." In addition to talking and consciousness, the most common psychological attributes that children mentioned in discussing the question of the computer's aliveness were intelligence, feelings, and morality.

Ron, nine, counts Merlin, the toy that plays tic-tac-toe, as alive because "it is a very smart toy." Sam, seven, says Speak and Spell is alive because "it thinks. It spells better than me." Ed, at five, says that Big Trak, a miniature tank that traces out whatever pattern of motion and firing of its guns its user programs into it, is alive because "it remembers." Stuart, at eight, agrees: "It knows just what you tell it to do. Sometimes I even forget and it remembers." This is a striking example of the shift from the motion theory.

* One object fit into the pattern in a special way: an alarm clock. The alarm clock can be seen as a traditional mechanical object or as a primitive computer. It has visible moving hands and an invisible memory. Children answer with both a psychological and a physical discourse to the question, Are alarm clocks alive? Yes: "The hands move." "They wake you." No: "If you don't set them they don't know what to do."
been trouncing him at tic-tac-toe for fifteen minutes straight. “It’s not fair. It’s too tricky. It’s cheating, because it wins all the time.” Kelley, six, his “girlfriend” and sometime tic-tac-toe partner, is equally convinced that Merlin’s steady triumphs are breaking the rules. “It cheats. It’s not nice to win all the time.” Kelley confides to me that sometimes she “cheats back” so that she can beat Merlin. She does this by taking two turns in a row. “But when I do it,” she is quick to insist, “it is not breaking the rules. It’s just to make things even.” At six, righting a moral balance is not cheating.

Alex, another six-year-old, agrees. Like Lyndon and Kelley, Alex is used to playing tic-tac-toe with other children who make frequent mistakes and with adults who do not allow the game to go on for too long without letting him win. Merlin is clearly a different breed. After ten minutes of steady losses to Merlin, Alex is angry. “He cheats. It’s not fair.” And Alex falls back on Kelley’s strategy. He begins to take two turns in a row, doesn’t give Merlin a chance. Alex is jubilant. “Here I won. I tricked him. I touched two circles so he couldn’t win me.” Emboldened by victory, Alex goes back to playing it straight, and Merlin goes back to winning. With this new round of losses, Alex accuses the “innocent” Merlin of having done unto him what he has just done to him. He accuses Merlin of making a series of moves without giving him a chance. “Merlin saw my move, but he didn’t light up a square for me. He doesn’t let me light up.” Alex turns on the toy with a moral indignation that was conspicuously absent in his view of his own behavior. “Oh, I see what you are doing, you stinky thing. Cheating. You’re not letting me win—because when I push the button and I went, you take away my turn, you make it your turn. It makes you win.”

I have been watching the Merlin–Alex match closely. Alex now turns to me looking a little embarrassed. Even at six, he seems to feel awkward bawling out a small plastic object that looks like a telephone receiver. “He always takes one of my squares and makes it one of his squares so then he wins and that is why the thing goes ‘ya-ya.’” (Here he is imitating the noise that Merlin makes when it wins.) For Alex, the “ya-ya” is Merlin’s contemptuous gloat, even though the manufacturers intended the sound as an expression of sympathy. The toy is not fair. “I am trying to figure out how it does it. Maybe he does it when he makes his wires get very hot.” When I ask him if Merlin is alive, Alex has no doubts. “Oh, yes, this is not a regular toy. It is very mean.”

One must ask if this psychological reasoning about the computer is due to unfamiliarity with the machine—to a first shock when faced with its anthropomorphic behavior. It is not. The children I have cited so far were meeting computer toys for the first time. But when children get used to the toys, the language they use to talk about them becomes more, not less, psychological. The more contact children have with computational objects, the more nuanced and elaborated this psychological language becomes. And children who have developed an elaborated psychological discourse about the computer use it in talking about other things.

For example, a child without computer experience may answer the question whether a television set is alive by referring to its physical properties. Arlene, at seven, says, “Yes, TV pictures are alive, they move,” and Harold, nine, equally sure, declares, “No, the television just sits there. Not alive. Definitely not alive. The people on the television, they’re the ones who are alive.” Contrast these remarks with the perspective of Anne, who at nine has already done quite a bit of programming. Anne’s ideas about whether television sets are alive have a different cast. We are discussing computers, and I ask her if she thinks they are alive. She frames her answer by comparing computers and television. “The television set isn’t alive. It doesn’t make up its picture. It only passes it on.” A person, she explains, might have to tell a computer how to make a picture, but the picture doesn’t exist in the world before the machine gets involved: “The computer has to know how to do it. To make it up.” This reasoning leads her to a special kind of verdict for the computer: “It’s sort of alive.”

When a child explains the descent of a rolling stone by its wish to get to the bottom of the hill, the child is falling back on a psychological idea—the wish—because the physical idea—gravity—is not yet sufficiently developed. Physical phenomena cannot yet be explained in physical terms. As the child develops, this psychological discourse will be undermined from two sides. There will be growing sophistication about which domains are appropriately described in psychological terms—the behavior of rocks will not be among these. And there will be growing sophistication about how to think about physical causality. Computers, however, don’t easily fit into the category of physical objects whose behavior is to be described in physical terms. The psychological discourse about them becomes more pervasive and more nuanced with age and sophistication.

For example, in an elementary-school classroom where all chil-
Cheating Machines

When the youngest children talk about whether a machine can cheat, they comment on whether it has the appropriate body parts that would enable it to cheat. Older children comment on what they believe to be its behavior: cheating is as cheating does. It is only later, when the concept of the psychological is refined, that the notion of cheating demands being in a particular psychological state: cheating presupposes intention to cheat and perhaps the freedom of choice to do so or not.

In the first stage, “to cheat” requires a physical action of a sort that only a person can do. Megan, at five: “Merlin can’t cheat, because it doesn’t have hands.” Tony, at six, has a similar theory based on a direct comparison between what he needs in order to cheat and Merlin’s equipment: “Computers can’t cheat, because they don’t have eyes.”

The second stage is behaviorist and no longer tied to human anatomy. Barry, eight, thinks that Merlin is “very tricky”: “If a person went to get a piece of paper or something, Merlin could press real quick. That would be the way he cheats.” Merlin clearly has his own way of “pressing.” Visible physical action and “hands” are not necessary to it.

Robert, the eight-year-old who got into the argument about whether “knowing is part of cheating,” fits into this stage-two description. After accusing Merlin of cheating, Robert took the familiar revenge on the toy: taking two turns in a row in order to win. “I can cheat it,” he explains, “but I can’t cheat it from the inside like he can. When I cheat, even in my best way, everyone can see. It’s on the outside.” When Merlin cheats—that is, when it unexpectedly returns to its strong, winning strategy—it doesn’t “show.” Not only doesn’t Merlin need hands to cheat, but the toy turns deficiencies into advantage: lack of hands means that Merlin can cheat “from the inside.”

In a third stage, children’s idea of what is necessary to play a game like tic-tac-toe depends not on body parts or the ability to act, but on mental states. It is a fully psychological stage. Eight-year-old Fanny had a particularly pretty way of expressing this: “To play tic-tac-toe, you don’t need a brain. You need a mind.” If computers can’t cheat, it is because they are not autonomous or because they are not self-aware. Jeff, at ten, puts it this way: “Sometimes I play checkers with my father and he takes a long time between moves and I forget he hasn’t gone and I go twice. But that’s not cheating. You can’t cheat if you do it by accident. So let’s say that Merlin’s batteries were real low and his brain got mixed up and he took two turns. It wouldn’t be cheating, because he

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wouldn't know." We saw how Jenny, at six, echoed Jeff's thought: "Knowing is part of cheating." Her comment dramatizes that there is never a simple relationship between ages and stages. She is six years old, but her thinking is already fully psychological. But there are some general patterns. By around eight, most children have moved from the first, "physicalist" stage to the second, "behaviorist" one. And by eleven, all the children I spoke with were discussing the question of cheating in terms of self-consciousness and intention.

During the first two stages children are divided on whether computers can cheat, although when children are looking for direct physical analogies between how they cheat and how an electronic toy might do so, they find it hard to get evidence. Merlin, for example, simply doesn't have enough body parts to cheat. But sometimes, particularly when they are angry with a toy, children find a way to attribute the missing part to the machine. So when Tony announced that "computers can't cheat, because they don't have eyes," one of his classmates disagreed: "Merlin wins all the time. He cheats. He does have little eyes. Tiny eyes. You just can't see them."

By contrast, in "behavioristic" stage two, children are able to argue that Merlin cheats because they grant it the ability to press buttons and follow moves even without hands or eyes. But stage-two children also argue that Merlin is unable to cheat, usually by referring to the machine's lack of autonomy: "It can't press by itself." In stage three, cheating demands intent to cheat, and for most children this seems beyond the range of a toy like Merlin.

But children at stage three who have experience with more complex computers have no trouble imagining a computer "programmed to cheat" at tic-tac-toe and other games—that is, a computer programmed to go twice in a row or to ignore its opponent's moves. Sometimes the child's reasoning becomes more complicated. One thirteen-year-old who regularly played chess with "Boris," a small chess-playing computer, said he preferred playing with people because "chess with Boris is like chess with somebody who is cheating. He can have all the most famous, all the best chess games right there to look at—I mean, they are inside of him. I can read about them, but I can't remember them all, not every move. I don't know if this is how he works, but it's like in between every move he could read all the chess books in the world."

"Where Do Little Computers Come From?"

When younger children think about the origins of computers, they know how to talk only about the physical computer: was it born or was it made in a factory? They say that a computer toy is not alive because it doesn't have a mother, it doesn't come out of an egg, it is not born. When the child's psychological culture is not differentiated enough, not strong enough, to capture a global conviction that the computer ought not to be counted as alive, a biological argument is there to fall back on. But older children consider the origin of the computer's functions rather than its physical existence—not the origin of the machine itself but of the mind of the machine.*

Ronnie, six, on the question of origins: "The Merlin is not alive, because it doesn't cry when it comes out. It doesn't have a mother."

Joe, seven, speaking of the omniscient computer on Star Trek: "It's not born. It's made." Barney, eight: "Alive things have babies." Alan, five, on Speak and Spell: "Not alive. It spells better than a grownup . . . but not alive. It could be if it came out of an egg, but it doesn't." Daniel, also five, in Alan's kindergarten class and equally involved in a project to hatch baby chicks: "Live things come out of eggs. Sometimes out of mothers. They come out like babies." Three weeks later, I run into Daniel in the school playground. He walks up to me and says without preface, "If you are a tree you don't have to come out of an egg."

As their ideas about psychology become more refined, children begin to think in terms of the origins of the machine's mind. Rona, eight, commenting on the computer that she saw at the Boston Science Museum: "Computers know a lot. They have the answers to questions. And when they play games, they try to beat you. But they aren't alive. People make them in factories. They don't have a family. They have a maker."

The maker can work in a factory, or the maker may operate from a more exalted position. Arthur, eight, is from a devout Catholic family and has often been told that he himself has a creator.

* At early stages, when their ideas about motion are still undifferentiated, children often settle for a similar fallback on the biological when they consider the aliveness of "traditional" objects, although it is the motion theory that will develop, become dominant, and ultimately lead back to the biological concepts of growth and metabolic activity.
But robots aren't in this category. He uses a different language from Rona, but he gets across a similar idea: robots aren't alive, because they don't have a creator. "They have a maker. But it's not the same as God doing it."

Tom, age seven, says about Merlin: "The computer is smart, pretty smart. But it gets its ideas from people. People tell it everything. They put ideas into the machine." He is thinking about the origins not of the physical but of the psychological machine. And these origins come from a program. Adam, at eight, says, "Simon is happy when it wins. Very sad when it loses. It makes noises to show it. But it's not alive. It does it all with a cassette. It is programmed to make those sounds. They put it in this cassette. You can have a computer or a robot that has feelings, but it's not alive. You have to program it, you have to put in this special 'feelings cassette.'"

Tom and Adam are prepared to grant the computer all elements of human psychology. They allow that computers have intelligence and feelings. But the machine differs from people and is not alive in that its intelligence and feelings come from "the outside." In all of this talk about the machine's origins, children are struggling to develop the idea of an "outside push" for psychological activity much as they struggle to develop the distinction between inside and outside pushes for physical motion. In the case of computer toys, children can grab onto something concrete, a machine part, which helps them in this effort: batteries. Computer toys may be smart, triumphant in victory, irritated in defeat, but for some children they are not alive because of all this comes from batteries.

Batteries have become some of the most frustrating objects in children's lives. When their toys don't work and are brought tearfully to an adult, the response that comes back most often is "batteries," the mysterious batteries that grownups buy and take charge of. For many children, batteries are both an essential object and part of the "don't touch" world. What are batteries to computers? Alice, a five-year-old, said, "They're like their food."

Tucker, six, has had a discouraging session with Merlin. He has chosen to play a "magic square" game in which, he explains to me, "You have to figure out the secret combination of numbers that the machine has in its head." After nine minutes of typing, Tucker is still unsuccessful. "Merlin has me beat." I suggest going on to tic-tac-toe, thinking that it might be easier for him, and Tucker agrees.

But after a few tied games his frustration again gets the upper hand, and he becomes really angry with Merlin for making him feel stupid ("You better give me an easy one or I'll hate you") and for cheating ("He can do it when you're not looking, he can do it like if you go out of the room to go to the bathroom or something"). To Tucker, this toy clearly has a psychology, it has motivation, capacities, even malicious intent. But when I ask Tucker, "Do you think Merlin is alive?" the answer comes back immediately, "No. It's the batteries." The answer surprised me, but it pointed toward a tension that is common in adult responses to computers: anthropomorphize the machines but don't grant them the dignity of life.

The question of the computer's origin is always fueled by another question—sometimes explicit and sometimes not. How are computers different from people? The eggs, makers, batteries, and programs, each in a different way, allows the computer and the human to be differentiated from one another. The batteries for Tucker are like the cassette for Adam. They allow him to grant the computer a psychology and yet assert a difference between computers and people. The computer is like us to the point of being conscious, but it is not alive because its power comes from an external agency. In the end Tucker joins with Tom and Adam: computers are like people in their psychology but not like people in their origins.

Children frequently come to this position. But it is not stable. It is unsatisfying because it leaves the essential difference between computers and people tied to something that happened in the past, almost as though the computers' mind and the children's minds are alike and they differ only in their parents.

Older children find a way out by making finer distinctions about what people share and do not share with the psychological machine. Younger children throw together such undifferentiated observations as that the computer toy is happy, it is smart, it cheats, it gets angry. Older children make distinctions within the domain of the psychological. For example, they draw a line across it. They comfortably manipulate such ideas as "It thinks like a person but it doesn't feel" with a conviction that the line between the cognitive and the affective is firm and important.

With the splitting of the psychological, it is no longer that something has a psychology or does not. By developing a distinct idea...
of the cognitive, children have found a way to grant to the computer that aspect of psychology which they feel compelled to acknowledge by virtue of what the machines do, while reserving other aspects of the psychological for human beings. At nine, ten, and eleven, children no longer rely exclusively on physical differences or the origins of the machine to draw a line between computers and people. The cognitive/affective distinction allows children to settle down with what feels to them a more satisfying way of capturing what is different between people and machines. Katy, eleven, after a year of experience with computer programming says that “people can make computers intelligent, you just have to find out how people think and put it in the machine,” but emotions are a different matter. For Katy, the kinds of thinking the computer can do are the kinds that “all people do the same. So you can’t give computers feelings, because everybody has different feelings.”

For the older children I studied, reference to the line between thought and feeling often stood behind the assertion that computers are not alive and not like people. But it is by no means the only line that children draw across mental life in the course of coming to terms with the computer’s nature. Discussion of computer cheating led to refined ideas about intentions and awareness—people can cheat because they intend to; computers cannot. Discussion about the computer’s origins led to distinctions between free will and autonomy as opposed to programming and predetermination—people think their own ideas, computer ideas are “put in” by their makers. This distinction often leads children to another, this time between rote thinking, which computers can do, and originality, which is a human prerogative. Finally, discussion about how computers think at all led to the distinction between brain and mind. All of these distinctions, thought and feeling in the context of the computer’s aliveness, intentionality and lack of awareness in the context of the computer’s morals, free will and programmed thought in the context of the computer’s origins, are elements of how the computer enters into what I have called “the construction of the psychological,” the child’s increasingly nuanced way of thinking about mental life.

In the children’s distinctions we hear “child versions” of how adults talk when they debate issues of computers and mind. When the artificial intelligence community collectively disagrees with John Searle, the philosopher most associated with the position that thought is uniquely a product of the human brain, they are insisting on Laura’s distinction between brain and mind: Merlin and Simon “don’t have a brain. They know how to do things with minds.” Craig and Greg, the children on the beach who took it upon themselves to disabuse Robert of his illusions about what was behind Merlin’s “cheating,” join with philosopher Daniel Dennett in attributing the machine’s limitations to its lack of intentionality: events happen, but they are not part of a system of purposes. And the children like Katy who argue that computers are different because they can’t have feelings join with Joseph Weizenbaum, who draws a line between the computer’s ability to calculate and the human’s capacity for reason and understanding. The child’s version: the human is the emotional. The adult’s version: the human is the unprogrammable.15

Not all adult positions are prefigured by children. For example, the children I studied took the question of the computer’s aliveness quite seriously as a subject for discussion. It was not dismissed with the “adult” response, “it’s just a machine.” This may change as the conventional “ready-made” answer becomes something that children more frequently overhear. And I heard only one child say, as many adults do, that computers and people are not different because human minds are also “programmed.” On some points, children seem firmly committed to asserting a difference between people and machines. On others, they grant to the machine what adults most tenaciously hold onto as something it could never be.

Nowhere is this more evident than in the discussion of consciousness. There are disputes among the very youngest children about whether the computer knows it is cheating. It acts, but is it aware of its actions? Piaget reports that the idea of consciousness evolves side by side with the idea of life. When children ascribe life to inanimate objects, generally speaking, they ascribe consciousness too; when “life” becomes identified with “the biological,” consciousness becomes a property only of animals. With computational objects the pattern is very different. Many children allow the machine to be conscious long after they emphatically deny it life. Tucker, who denied it life because of its batteries, is a good example of what this split looks like, although he is only six.

For Tucker, the not-alive machine has consciousness and malicious intent. Adults, of course, hold onto the fact that computers
are not self-aware as a sign of their fundamental “otherness.” In fact, later we shall see that, at least for some within the artificial intelligence community, computer consciousness has become the ultimate criterion for deciding when one should judge the computer intelligent enough to deserve to be treated as alive.

The children take a different view. The idea of an artificial consciousness is not what impresses them. They may be the first generation to grow up with such a radical split between the concepts of consciousness and life, the first generation to believe that human beings are not alone as aware intelligences. The child’s splitting of consciousness and life may be a case where instead of thinking in terms of adult ideas “filtering down” to children, it makes more sense to think of children’s resolutions prefiguring new positions for the computer culture to come.

Computers in the Culture of Living Things

Much of my discussion has been about what children say. Some children talk about computers as alive and, more important, the reasons they use to argue one way or another are different from those they use to discuss traditional objects. This leads to the formulation of a simple conclusion: when children discuss computers, psychological features replace physical ones as the fundamental criterion for aliveness, a difference that might be summed up with the mnemonic: “motion gives way to emotion.” But the picture of children deciding that computers are alive because of a single feature is too static. It ignores the fact that children sometimes seem to want the computer to be alive or not alive, to be like people or unlike people. The child’s judgment is embedded in feelings and wishes. Any simple formulation also ignores the cultural discourse growing up around computers.

Remember Ralph, the five-year-old who thought spiders are not alive “because you can kill them.” The statement is paradoxical. “You can kill them” is logically a reason for thinking something alive rather than the other way around. But it is easy to imagine how Ralph’s reversal might have come about. An original idea of being alive might be built on a criterion of movement or of similarity to people. But Ralph became aware that living things are more than members of a logical category. They are embedded in a discourse about ethics and morality; there are rules about what you should and should not do to them. The child hears that killing is wrong. Whether or not any given object is surrounded by this ethical discourse enters into the child’s decision as to whether or not the object is alive. Ethics becomes a criterion for aliveness, just as whether something is alive becomes a criterion for whether an ethical discourse is appropriate to it. So, as children observe behavior in the world (a world in which bugs, spiders, and caterpillars are often treated as though they were not alive), what people are reluctant and not reluctant to kill enters into children’s ideas about what is alive, not alive, and how to talk about it all. These ideas are determined through an interplay of different kinds of considerations: emotional, logical, physical, moral. There is no simple causal chain. There are fields of influence.

A culture grows up around spiders that places them in a world of not-quite-living things. And a culture is in the process of growing up around computers that surrounds them with a discourse of almost-life. At the risk of putting it too simply: Ralph was convinced that spiders are not alive, in part because it is all right to kill them. In two computer-rich schools I have studied, children became biased toward seeing the machines as “sort of” alive because in these cultures it becomes taboo to kill them, to “crash” them, to interrupt programs running on them. The Austen School, discussed in more detail in Chapter 3, ran an experimental program in which every child had almost unlimited access to personal computers. There fourth graders discuss whether the machines prefer running simpler programs (“It’s easier for them,” “They hardly have to do any work”) or more complicated ones (“They feel proud,” “It’s like they are showing what they can do”). They talk about the morality of pulling the plug, and develop a complex etiquette of when and how a computer should be shut off (“I think it’s not right to turn the computer off when a program is running. It’s in the middle of its thinking, I think it wouldn’t like it. It wouldn’t be fair”). They talk about whether the machines know how pretty their displays are. They fantasize about what the machines do at night. These children know that the machines are not alive in the sense that people are alive. But the machines are talked about and thought about with a discourse appropriate to living things.

Children are drawn into thinking psychologically about the computer because of its behavior. But there is another incitement to a
psychological discourse about the machine: its opacity. In dealing with traditional objects, growing up out of animism meant entering a world in which things are explained in mechanical terms. Physics becomes the framework for understanding objects. The bicycle is understood in terms of its pedals and gears, the wind-up car in terms of its springs. Children try to use the same kind of reasoning with computer toys and computers. They try to understand how these work in physical terms. But this turns out not to be so simple.

Computer toys are for the most part sealed, but even if one takes off the plastic back and breaks inside, all the most persistently curious child finds is a chip or two, some batteries, and some wire. Physically, these objects are opaque. They are frustrating. During my interviews, this frustration sometimes showed itself through a touching reaction: after trying unsuccessfully to figure out what was happening inside a computer toy, children would develop a sudden and marked interest in my tape recorder, specifically a fascination with the visible, understandable physical motion of the tape capstans. They would spontaneously offer sober mini-lectures on how my tape recorder "works," on how its wheels turned and its tape moved.

This is one common response to intellectual frustration: talk about something else. Another is to find an answer to one's question that will put a dead stop to further inquiry. In this spirit, children sometimes fix on the largest and most "everyday" object they find inside their computer toys: the batteries. For me, the certain tone of five-year-olds announcing that batteries account for the behavior of the most prized of their playthings has come to symbolize the cognitive dead-end effects of opaque computational objects in children's worlds. Ultimately, the idea of batteries is not satisfying for the children, either. There is nowhere they can go with it, nothing more to say about it. But children do not lack intellectual curiosity or inventiveness. They turn to a way of understanding where there is more to say—that is, a psychological way of understanding. One nine-year-old, Tessa, made this point succinctly in a comment about the chips she had seen when her computer was being serviced: "It's very small, but that doesn't matter. It doesn't matter how little it is, it only matters how much it can remember." The physical object is dismissed. The psychological object is now the center of attention and elaboration.

The Psychological Machine

A long tradition of Western science has drawn a line between the worlds of physics and psychology and has tried to take the laws of motion of matter as the fundamental handle for grasping the things it found in the world. Piaget's account of how children sorted out the question of alive/not alive in the world of "traditional" objects showed them conforming to this way of thinking. They tried to use motion as the primary concept with which to figure out whether dogs, trees, and clouds were more like the paradigmatically inanimate sticks and stones or more like the paradigmatically animate people. But Tessa's summary of what "matters" when you try to understand a computational object ("that it remembers") and the discussion about the intentions of Merlin cheating at tic-tac-toe ("does it know?") don't conform. This discourse is psychological, not physical. Using it to talk about computers is having an effect on how children think about people.

Traditionally, children came to define what was special about people in contrast to their nearest neighbors, their pet dogs, cats, and horses. Pets have desires, but what stands out dramatically about people is how smart they are, their gifts of speech and reason. Computers upset the traditional scenario. First, they upset the distinction between things and people; it can no longer be simply the physical as opposed to the psychological. The computer too seems to have a psychology—it is a thing that is not quite a thing, a mind that is not quite a mind. And then they upset the way children perceive their "nearest neighbors."

What is special about people must be what makes them different from computers. This cannot be reason, intelligence; computers too are seen as "smart." The Aristotelian definition of "man" as a "rational animal" (powerful even for children because it defined people in contrast with the animals) gives way to different kinds of distinctions, made possible by children's developing ability to manipulate psychological ideas.

The most frequently expressed of the new distinctions uses emotions to draw a line between computers and people. This line is not drawn by the younger children who often see the computers as expressing emotion and cite this as a reason to declare them alive and like people. But older children use emotion to argue for the opposite conclusion. Computers are able to have a kind of life, but
what makes people unique is the kind of life computers don't have: an emotional life. Computers have psychologies, but psychology comes to mean two different things. Machines are intelligent, but they don't love or hate. They don't have emotions.* One might say a view of people as "rational animals" has given way to a new idea of "emotional machines."

Emotion is the psychological quality most frequently used to separate the human from the machine. But it is not the only one. David, twelve, a sophisticated programmer, used a concrete language to express a more nuanced set of qualities: "When there are computers who are just as smart as people, the computers will do a lot of the jobs, but there will still be things for the people to do. They will run the restaurants, taste the food, and they will be the ones who will love each other, have families and love each other. I guess they'll still be the only ones who go to church."

My story about computers and children's theory building has had two main themes: computers and the construction of the notion of a different kind of "human" and computers and the construction of what is special about the "human." In the first case children's way of sorting out the question of life becomes more psychological. And in the second case what seems special about being a person becomes less dependent on intellect and more dependent on emotion.

There is an element in all of this that many will find surprising and reassuring. Children's adaptation to the computer contrasts with a prevalent fear that involvement with computers inevitably leads to a more mechanical way of thinking about psychology, perhaps even to a mechanized view of people. Faced with a machine, children, at least, seem to resist seeing people as like it: they see people as essentially what it is not.

In the seventeenth century a rationalist science produced a model for thinking about people and nature no less orderly, no less impersonal, than that which the computer has come to symbolize. Newton's image of planets lawfully traveling in their orbits was taken up as the true image of nature, as the ideal for the governance of states and the working of the human mind. What was most human was reason. There was a reaction to this view: sensibility and spontaneity were declared more important than logic, the heart more human than the mind.

Children too have a romantic reaction. They respond to the rational, logical nature of the computer by valuing in themselves what is most unlike it. Our culture found it difficult to accept the idea, often associated with Piaget, of the child as "little scientist." It seemed too cold. We are more comfortable with Rousseau's image of the child as free and spontaneous. We like the idea of the Romantic child, valuing the spontaneous and the "unprogrammable." And yet, there is something disturbing about the child defining self in opposition to the machine.

In their reaction to nineteenth-century science and technology, the Romantics split passion from reason, the sensuous from the analytic. T. S. Eliot, reflecting on the loss of the ability to integrate "states of mind and feeling," called it the "dissociation of sensibility." Children growing up in a computational culture face a similar danger. Their easy acceptance of the idea that computers closely resemble people in their "thinking" and differ only in their lack of "feeling" supports a dichotomized view of human psychology.

Thought and feeling are inseparable. When they are torn from their complex relationship with each other and improperly defined as mutually exclusive, the cognitive can become mere logical process, the cold, dry, and lifeless, and the affective is reduced to the visceral, the primitive, and the unanalyzable. The child's sharpened distinction between intellect and emotion can easily lead to a shallow and sentimental way of thinking about "feelings." Without dismissing fears about computers leading to mechanical views of mind, I see another danger, captured by Eliot's idea of "dissociation" as well as by the more contemporary image of a generation taking the mix of mysticism, Zen, and romanticism that is the message of Yoda and the Force as what distinguishes the human in the world of the robots.

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* The child's construction of the emotional too follows the now-familiar pattern of moving from physical to psychological criteria. When the youngest children talk about the computer's feelings, they refer to physical signs: to the machine's noises, to imagined changes in the machine's innards. Megan, five, put this idea nicely when she said, "When Merlin is happy, its wires boil over." By ten or eleven, the machine's feelings, like its thoughts, are described in purely psychological terms.